

Please type a plus sign (+) inside this box → ☐

PTO/SB/05 (12/97)
Approved for use through 09/30/00. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 503.30414C13

Total Pages

First Named Inventor or Application Identifier

KATO, et al.

Express Mail Label No.

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ☒ Fee: \$760.00

Please charge any shortages in the fees or credit any overpayments thereof to the deposit account of Antonelli, Terry, Stout & Kraus, Deposit Account No. 01-2135.

6. ☐ Microfiche Computer Program (Appendix)

7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)

- a. ☐ Computer Readable Copy
b. ☐ Paper Copy (identical to computer copy)
c. ☐ Statement verifying identity of above copies

2. ☒ Specification Total Pages 20

3. ☒ Drawing(s) (35 USC 113) Total Sheets 1

4. Oath or Declaration Total Pages 2

- a. ☐ Newly executed (original or copy)
b. ☒ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional with Box 17 completed) [Note Box 5 below]

i. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ☒ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney (when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
12. ☒ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. ☐ Small Entity ☐ Statement filed in prior application, Status still proper and desired
15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☒ Other: Claim for Priority...

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☒ Divisional ☐ Continuation-in-part (CIP) of prior application No: 09,177,495

18. CORRESPONDENCE ADDRESS

☒ Customer Number or Bar Code Label

020457

(Insert Customer No. or Attach bar code label here)

11. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

NAME William I. Solomon

SIGNATURE

DATE

September 7, 1999

REG. NO.

28,565

ANTONELLI, TERRY, STOUT & KRAUS, LLP

SUITE 1800

1300 NORTH SEVENTEENTH STREET
ARLINGTON, VIRGINIA 22209

TELEPHONE
(703) 312-6600
FACSIMILE
(703) 312-6666
E-MAIL
email@antonelli.com

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): KATO, et al.

Serial No.: Divisional of application
Serial No. 09/177,495

Filed: September 7, 1999

For: VACUUM PROCESSING APPARATUS AND OPERATING
METHOD THEREFOR

Group:

Examiner:

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

September 7, 1999

Sir:

Please amend the above-identified application, prior to
examination thereof, as follows:

IN THE SPECIFICATION

Please amend the specification as follows:

Page 1, delete lines 1-8 in their entirety, and
substitute therefor the following:

--This application is a Divisional application of
application Serial No. 09/177,495, filed October 23, 1998,
which is a Continuation application of application Serial No.
09/061,062, filed April 16, 1998, which is a Continuation
application of application Serial No. 08/882,731, filed June
26, 1997, which is a Divisional application of application
Serial No. 08/593,870, filed January 30, 1996, which is a

09/061,062

Continuing application of application Serial No. 08/443,039, filed May 17, 1995, which is a Divisional application of application Serial No. 08/302,443, filed September 9, 1994, which is a Continuing application of application Serial No. 08/096,256, filed July 26, 1993, which is a Continuing application of application Serial No. 07/751,951, filed August 29, 1991.--.

REMARKS

Applicants have amended their specification in order to refer to all prior applications of the present application, in view of the requirements of 35 USC 120. Clearly, this amendment to the specification does not add new matter to the application.

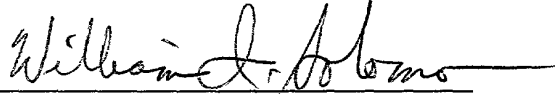
Entry of the present amendments, and examination of the above-identified application on the merits in due course, are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Deposit

Account No. 01-2135 (Case No. 503.30414C13) and please credit
any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



William I. Solomon
Registration No. 28,565

1300 North Seventeenth Street
Suite 1800
Arlington, VA 22209
Tel.: 703-312-6600
Fax.: 703-312-6666

WIS/slk

09/20/00 12:50:00 PM

5 This application is a Continuation application of Serial No. 08/882,731, filed June 26, 1997, which is a Divisional application of Serial No. 08/593,870, filed January 30, 1996, which is a Continuing application of Serial No. 08/443,039, filed May 17, 1995, which is a Divisional application of Serial No. 08/302,443, filed September 9, 1994, which is a Continuing application of Serial No. 08/096,256, filed July 26, 1993, which is a Continuing application of Serial No. 07/751,951, filed August 29, 1991.

10 BACKGROUND OF THE INVENTION

Field of the Invention

15 This invention relates to a vacuum processing apparatus and operating method therefor. More specifically, the present invention relates to a vacuum processing apparatus having vacuum processing chambers the inside of which must be cleaned, and its operating method.

Description of the Prior Art

20 In a vacuum processing apparatus such as a dry etching apparatus, a CVD apparatus or a sputtering apparatus, a predetermined number of substrates to be treated are stored as one unit (which is generally referred to as a "lot") in a substrate cassette and are loaded in the apparatus. The substrates after being
25 processed are likewise stored in the same unit in the substrate cassette and are recovered. This is an ordinary method of operating these apparatuses to improve the productivity.

30 In such a vacuum processing apparatus described above, particularly in an apparatus which utilizes a reaction by an active gas, as typified by a dry etching apparatus and a CVD apparatus, reaction products adhere to and are deposited on a vacuum processing chamber with the progress of processing.
35 For this reason, problems such as degradation of vacuum performance, the increase of dust, the drop of the levels of optical monitoring signals occur. To solve these problems, conventionally the insides of the vacuum processing chambers are cleaned
40 periodically. Cleaning operations include so-called "wet cleaning" which is wiping-off of the adhering

5 matters by use of an organic solvent, etc., and so-called "dry cleaning" in which an active gas or plasma is used for decomposing adhering matters. Dry cleaning is superior from the aspect of the working factor and efficiency. These features of the dry cleaning have become essential with the progress in automation of production lines.

10 An example of vacuum processing apparatuses having such a dry cleaning function is disclosed in Japanese Utility Model Laid-Open No. 127125/1988. This apparatus includes a preliminary vacuum chamber for introducing wafers to be treated into a processing chamber from an atmospheric side to a vacuum side, which is disposed adjacent to the processing chamber
15 through a gate valve, dummy wafers are loaded in the preliminary vacuum chamber and are transferred into the processing chamber by exclusive conveyor means before the processing chamber is subjected to dry cleaning, and the dummy wafer is returned to the vacuum
20 preparatory chamber by the conveyor means after dry cleaning is completed.

SUMMARY OF THE INVENTION

25 In the prior art technology described above, the structure of the vacuum processing apparatus is not much considered. The preliminary vacuum chamber for storing the dummy wafers must have a large capacity, the exclusive conveyor means is necessary for transferring the dummy wafers and thus, the apparatus is complicated in structure.

30 Dummy wafers used for plasma cleaning are again returned to the preliminary vacuum chamber and are made to stand by. In this instance, reaction products generated during plasma cleaning and residual gas used for plasma cleaning adhere on the used dummy wafers.
35 Thereafter, normal processing for wafers is resumed.

Therefore, the used dummy wafers and unprocessed wafers exist in mixture inside the preliminary vacuum chamber and this state is not desirable from the aspect of contamination of unprocessed wafers.

5 The present invention provides a vacuum processing apparatus which solves the problems described above, is simple in structure, prevents contamination of unprocessed substrates and accomplishes a high production yield. A vacuum
10 processing apparatus having vacuum processing chambers the insides of which are dry-cleaned after substrates to be treated are processed in vacuum is provided with first storage means for storing substrates to be
15 treated, second storage means for storing dummy substrates, the first and second storage means being disposed in the air, conveyor means for transferring the substrates to be processed between the first
20 storage means and the vacuum processing chambers and for transferring the dummy substrates between the second storage means and the vacuum processing chambers, and control means for controlling the
25 conveyor means so as to transfer the dummy substrates between the second storage means and the vacuum processing chambers before and after dry cleaning of the vacuum processing chambers. A method of operating
30 a vacuum processing apparatus having vacuum processing chambers the insides of which are dry-cleaned after substrates to be processed are processed in vacuum comprises the steps of disposing first storage means
35 for storing the substrates to be processed together with second storage means for storing dummy substrates in the air atmosphere, transferring the substrates to be processed between the first storage means and the vacuum processing chambers and vacuum-processing the substrates to be processed, and transferring the dummy

substrates between the second storage means and the vacuum processing chambers before and after dry-cleaning of the vacuum processing chambers.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Fig. 1 is a plan view of a dry etching apparatus as an embodiment of a vacuum processing apparatus in accordance with the present invention; and

 Fig. 2 is a vertical sectional view taken along line 1 - 1 of Fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 As substrates to be processed are processed in a vacuum processing apparatus, reaction products adhere to and are deposited in vacuum processing chambers. The reaction products adhering to and deposited in the
15 vacuum processing chambers are removed by disposing dummy wafers inside the vacuum processing chambers and by conducting dry-cleaning. To carry out dry cleaning, the timings of dry cleaning of the vacuum processing chambers are determined and during or after
20 the processing of a predetermined number of substrates to be processed, dummy substrates are conveyed by substrate conveyor means from dummy substrate storage means disposed in the air atmosphere together with processed substrate storage means, and are then
25 disposed inside the vacuum processing chambers. After the dummy substrates are thus disposed, a plasma is generated inside each of the vacuum processing chambers to execute dry-cleaning inside the vacuum chamber. After dry-cleaning inside the vacuum
30 processing chambers is completed, the dummy substrates are returned from the vacuum processing chambers to the dummy substrate storage means by the substrate conveyor means. In this manner, a preliminary vacuum chamber and an exclusive transfer mechanism both
35 necessary in prior art techniques become unnecessary,

and the apparatus structure gets simplified. The dummy substrates used for the dry-cleaning and the substrates to be processed do not co-exist inside the same chamber, so that contamination of substrates to be processed due to dust and remaining gas is prevented and a high production yield can be achieved.

Hereinafter, an embodiment of the present invention will be explained with reference to Figs. 1 and 2.

Figs. 1 and 2 show a vacuum processing apparatus of the present invention which is, in this case, a dry-etching apparatus for etching wafers, i.e., substrates to be processed by plasma.

Cassette tables 2a to 2c are disposed in an L-shape in this case in positions such that they can be loaded into and unloaded from the apparatus without changing their positions and postures. In other words, the cassettes 1a to 1c are fixed always in predetermined positions on a substantially horizontal plane, while the cassette tables 2a and 2b are disposed adjacent to and in parallel with each other on one of the sides of the L-shape. The cassette table 2c is disposed on the other side of the L-shape. The cassettes 1a and 1b are for storing unprocessed wafers and for recovering the processed wafers. They can store a plurality (usually 25) of wafers 20 as the substrates to be treated. The cassette 1c in this case is for storing the dummy wafers for effecting dry-cleaning using plasma (hereinafter referred to as "plasma-cleaning") and recovering the dummy wafers after plasma-cleaning. It can store a plurality of (usually twenty-five pieces) dummy wafers 30.

A load lock chamber 5 and unload lock chamber 6 are so disposed as to face the cassette tables 2a

and 2b, and a conveyor 13 is disposed between the cassette tables 2a, 2b and the load lock chamber 5 and the unload lock chamber 6. The load lock chamber 5 is equipped with an evacuating device 3 and a gas introduction device 4, and can load unprocessed wafers in the vacuum apparatus through a gate valve 12a. The unload lock chamber 6 is similarly equipped with the evacuating device 3 and the gas introduction device 4, and can take out processed wafers to the atmosphere through a gate valve 12d. The conveyor 13 is equipped with a robot having X, Y, Z and θ axes, which operates so as to deliver and receive the wafers 20 between the cassettes 1a, 1b and the load lock and unload lock chambers 5 and 6 and the dummy wafers 30 between the cassette 1c and the load lock and unload lock chambers 5 and 6.

The load lock chamber 5 and the unload lock chamber 6 are connected to a transfer chamber 16 through the gate valves 12b and 12c. The transfer chamber 16 is rectangular, in this case, and etching chambers 11a, 11b and 11c are disposed on the three side walls of the transfer chamber 16 through gate valves 15a, 15b and 15c, respectively. A conveyor 14 capable of delivering the wafers 20 or the dummy wafers 30 from the load lock chamber 5 to the etching chambers 11a, 11b, 11c and of delivering them from the chambers 11a, 11b, 11c to the unload lock chamber 6 is disposed inside the transfer chamber 16. The transfer chamber 16 is equipped with an evacuating device 17 capable of independent evacuation.

The etching chambers 11a, 11b, 11c have the same structure and can make the same processing. The explanation will be given on the etching chamber 11b by way of example. The etching chamber 11b has a sample table 8b for placing the wafers 20 thereon, and

5 a discharge chamber is so provided as to define a
discharge portion 7b above the sample table 8b. The
etching chamber 11b includes a gas introduction device
10b for introducing a processing gas in the discharge
portion 7b and an evacuating device 9b for decreasing
the internal pressure of the etching chamber 11b to a
predetermined pressure. The etching chamber 11b
further includes generation means for generating a
microwave and a magnetic field for converting
10 processing gas in the discharge portion 7b to plasma.

15 A sensor 18 for measuring the intensity of plasma
light is disposed at an upper part of the etching
chamber. The measured value of the sensor 18 is
inputted to a controller 19. The controller 19
compares the measured value from the sensor 18 with a
predetermined one and determines the timing of
cleaning inside the etching chamber. The controller
19 controls the conveyors 13 and 14 to control the
transfer of the dummy wafers 30 between the cassette
20 1c and the etching chambers 11a to 11c.

25 In a vacuum processing apparatus having the
construction described above, the cassettes 1a, 1b
storing unprocessed wafers are first placed onto the
cassette tables 2a, 2b by a line transfer robot which
operates on the basis of the data sent from a host
control apparatus, or by an operator. On the other
hand, the cassette 1c storing the dummy wafers is
placed on the cassette table 2c. The vacuum
processing apparatus executes the wafer processing or
30 plasma cleaning on the basis of recognition by itself
of the production data provided on the cassettes 1a to
1c, of the data sent from the host control apparatus,
or of the command inputted by an operator.

35 For instance, the wafers 20 are sequentially
loaded in the order from above into the etching

chambers 11a, 11b, 11c by the conveyors 13 and 14, and are etched. The etched wafers are stored in their original positions inside the cassette 1a by the conveyors 14 and 13. In this case, from the start to the end of the operation, without changing the position and posture of the cassettes, the unprocessed wafers are taken out from the cassettes and are returned in their original positions where the wafers have been stored, and are stored there. In this manner, the apparatus can easily cope with automation of the production line, contamination of the wafers due to dust can be reduced and high production efficiency and high production yield can thus be accomplished.

As etching is repeated, the reaction products adhere to and are deposited on the inner wall of the etching chambers 11a to 11c. Therefore, the original state must be recovered by removing the adhering matters by plasma cleaning. The controller 19 judges the timing of this plasma cleaning. In this case, a portion through which the plasma light passes is provided in each of the etching chambers 11a to 11c. The sensor 18 measures the intensity of the plasma light passing through this portion and when the measured value reaches a predetermined one, the start timing of plasma cleaning is judged. Alternatively, the timing of plasma cleaning may be judged by counting the number of wafers processed in each etching chamber by the controller 19 and judging the timing when this value reaches a predetermined value. The actual timing of plasma cleaning that is carried out may be during a processing of a predetermined number of wafers in the cassette 1a or 1b, after the processing of all the wafers 20 in a cassette is completed and before the processing of wafers in the

next cassette.

Plasma cleaning is carried out in the following sequence. In this case, the explanation will be given about a case where the etching chambers 11a to 11c are
5 subjected to plasma cleaning by using three dummy wafers 30 among the dummy wafers 30 (twenty-five dummy wafers are stored in this case) stored in the cassette 1c.

Dummy wafers 30 which are stored in the cassette
10 1c and are not used yet or can be used because the number of times of use for plasma cleaning is below a predetermined one are drawn by the conveyor 13. At this time, dummy wafers 30 stored in any position in the cassette 1c may be used but in this case, the
15 position numbers of the dummy wafers in the cassette and their number of times of use are stored in the controller 19, and accordingly dummy wafers having smaller numbers of times of use are drawn preferentially. Then, the dummy wafers 30 are loaded
20 in the load lock chamber 5 disposed on the opposite side to the cassette 1a by the conveyor 13 through the gate valve 12a in the same way as the transfer at the time of etching of wafers 20. After the gate valve 12a is closed, the load lock chamber 5 is evacuated to
25 a predetermined pressure by the vacuum exhaust device 3 and then the gate valves 12b and 15a are opened. The dummy wafers 30 are transferred by the conveyor 14 from the load lock chamber 5 to the etching chamber 11a through the transfer chamber 16 and are placed on
30 the sample table 8a. After the gate valve 15a is closed, plasma cleaning is carried out in the etching chamber 11a in which the dummy wafers 30 are disposed, under a predetermined condition.

In the interim, the gate valves 12a, 12b are
35 closed and the pressure of the load lock chamber 5 is

returned to the atmospheric pressure by the gas introduction device 4. Next, the gate valve 12a is opened and the second dummy wafer 30 is loaded in the load lock chamber 5 by the conveyor 13 in the same way as the first dummy wafer 30, and evacuation is effected again by the evacuating device 3 to a predetermined pressure after closing the gate valve 12a. Thereafter, the gate valves 12b and 15b are opened and the second dummy wafer 30 is transferred from the load lock chamber 5 to the etching chamber 11b through the transfer chamber 16 by the conveyor 14. Plasma cleaning is started after the gate valve 15b is closed.

In the interim, the third dummy wafer 30 is transferred into the etching chamber 11c in the same way as the second dummy wafer 30 and plasma cleaning is carried out.

After plasma cleaning is completed in the etching chamber 11a in which the first dummy wafer 20 is placed, the gate valves 15a and 12c are opened. The used dummy wafer 30 is transferred from the etching chamber 11a to the unload lock chamber 6 by the conveyor 14. Then, the gate valve 12c is closed. After the pressure of the unload lock chamber 6 is returned to the atmospheric pressure by the gas introduction device 4, the gate valve 12d is opened. The used dummy wafer 30 transferred to the unload lock chamber 6 is taken out in the air by the conveyor 13 through the gate valve 12d and is returned to its original position in the cassette 1c in which it is stored at the start.

When plasma cleaning of the etching chambers 11b and 11c is completed, the second and third dummy wafers 20 are returned to their original positions in the cassette 1c.

In this way, the used dummy wafers 30 are returned to their original positions in the cassette 1c and the dummy wafers 30 are always stocked in the cassette 1c. When all the dummy wafers 30 in the cassette 1c are used for plasma cleaning or when the numbers of times of use of the wafers 30 reach the predetermined ones after the repetition of use, the dummy wafers 30 are replaced as a whole together with the cassette 1c. The timing of this replacement of the cassette is managed by the controller 19 and the replacement is instructed to the host control apparatus for controlling the line transfer robot or to the operator.

Although the explanation given above deals with the case where the etching chambers 11a to 11c are continuously plasma-cleaned by the use of three dummy wafers 30 among the dummy wafers 30 in the cassette 1c, other processing methods may be employed, as well.

For example, the etching chambers 11a to 11c are sequentially plasma-cleaned by the use of one dummy wafer 30. In the case of such plasma cleaning, unprocessed wafers 20 can be etched in etching chambers other than the one subjected to plasma cleaning, and plasma cleaning can thus be carried out without interrupting etching.

If the processing chambers are different, for example, there are an etching chamber, a post-processing chamber and a film-formation chamber, and wafers are sequentially processed while passing through each of these processing chambers, each of the processing chambers can be subjected appropriately to plasma cleaning by sending dummy wafers 30 during the processing of the wafers 20 which are stored in the cassette 1a or 2a and drawn and sent sequentially, by passing merely the dummy wafers 30 through the

processing chambers for which plasma cleaning is not necessary, and by executing plasma cleaning only when the dummy wafers 30 reach the processing chambers which need plasma cleaning.

According to the embodiment described above, the cassette storing the dummy wafers and the cassettes storing the wafers to be processed are disposed together in the air, the dummy wafers are loaded from the cassette into the apparatus by the same conveyor as the conveyor for transferring the wafers, at the time of cleaning, and the used dummy wafers are returned to their original positions in the cassette. In this way, a mechanism for conducting exclusively plasma cleaning need not be provided, and the construction of the apparatus can be simplified. It is not necessary to handle plasma cleaning as a particular processing sequence, but the plasma cleaning can be incorporated in an ordinary etching processing and can be carried out efficiently in a series of operations.

The dummy wafers used for plasma cleaning are returned to their original positions in the cassette placed in the air. Accordingly, the used dummy wafers and the wafers before and after processing do not exist mixedly in the vacuum chamber, so that contamination of wafers due to dust and remaining gas does not occur unlike conventional apparatuses.

The used dummy wafers are returned to their original positions in the cassette and the numbers of times of their use is managed. Accordingly, it is possible to prevent the confusion of the used dummy wafers with the unused dummy wafers and the confusion of the dummy wafers having small numbers of times of use with the dummy wafers having large numbers of times of use. For these reasons, the dummy wafers can

be used effectively without any problem when plasma cleaning is carried out.

Furthermore, in accordance with the present invention, the apparatus can have a plurality of processing chambers and can transfer wafers and dummy wafers by the same conveyor. Since plasma cleaning can be carried out by managing the timing of cleaning of each processing chamber by the controller, the cleaning cycle can be set arbitrarily, dry cleaning can be carried out without interrupting the flow of the processing, the processing can be efficiently made and the productivity can be improved.

As described above, according to the present invention, there are effects that the construction of the apparatus is simple, the substrates to be processed are free from contamination and the production yield is high.

WHAT IS CLAIMED IS:

1. A method of treating a sample in a vacuum processing chamber, comprising the steps of:

providing a cassette table, for mounting a cassette in which plural samples are stored, disposed under atmospheric pressure;

supplying said cassette to said cassette table using one of a mechanical transfer and a manual transfer;

carrying in the sample from said cassette to the vacuum processing chamber through a lock chamber;

treating the sample in said vacuum processing chamber; and

carrying out said treated sample to said cassette through said lock chamber.

2. A method of treating a sample in a vacuum processing chamber according to claim 1, wherein said mechanical transfer is performed by a mechanical transferring means.

3. A method of treating a sample in a vacuum processing chamber according to claim 1, wherein:

said treating in the vacuum processing chamber is carried out by processing the sample in the vacuum processing chamber according to one of recognition of product information which is given to said cassette, information which is sent from an upper rank control apparatus, and an order which is

inputted manually;

after completion of processing of all of the samples in said cassette, said all of the samples are stored in said cassette;

said cassette is exchanged with another cassette in which unprocessed samples are stored; and

after carrying out the exchange of said cassette with said another cassette, a processing of samples in said another cassette is carried out.

4. A method of treating a sample in a vacuum processing chamber according to claim 1, wherein said treated sample is carried out to a position of said cassette occupied by the sample before the sample was carried from the cassette to the vacuum processing chamber to be treated.

5. A method of treating a sample in a vacuum processing chamber according to claim 4, wherein the sample is carried in and is treated one by one.

6. A method of treating a sample in a vacuum processing chamber according to claim 3, wherein the sample is carried in and is treated one by one.

7. A method of treating a sample in a vacuum processing chamber according to claim 1, wherein the sample is carried in and is treated one by one.

8. A method of treating a sample in a vacuum processing chamber, comprising the steps of:

placing a cassette containing plural samples on a cassette table which disposed under atmospheric pressure, by one of a mechanical transfer and a manual transfer;

carrying out vacuum processing treating of said sample in the vacuum processing chamber according to one of recognition of product information which is given to said cassette, information which is sent from an upper rank control apparatus, and an order which is inputted manually;

after completing the vacuum processing treating of all of the plural samples in the cassette, storing said all of the plural samples in said cassette;

exchanging said cassette with another cassette in which unprocessed samples are contained; and

after exchanging said cassette with said another cassette, carrying out processing of samples in said another cassette.

9. A method of treating a sample in a vacuum processing chamber according to claim 8, wherein the processing of the samples in said another cassette is carried out in said vacuum processing chamber.

10. A method of treating a sample in a vacuum processing chamber according to claim 8, wherein said mechanical transfer is performed by a mechanical transferring means.

11. A method of treating a sample in a vacuum processing chamber according to claim 8, wherein the treated sample is carried out to a position of said cassette occupied by the sample when the cassette was placed on the cassette table.

12. A method of treating a sample in a vacuum processing chamber according to claim 11, wherein the sample is carried into the vacuum processing chamber and is treated therein one by one.

13. A method of treating a sample in a vacuum processing chamber according to claim 8, wherein the sample is carried into the vacuum processing chamber and is treated therein one by one.

14. A method of treating a sample contained in a cassette using plural vacuum processing chambers, comprising the steps of:

placing a transferred cassette on a cassette table which is disposed under a cassette transferring atmospheric pressure;

carrying said sample into a respective vacuum processing chamber;

vacuum treating the respective carried-in sample using said respective vacuum processing chamber;

after completing vacuum treating of all samples in the transferred cassette, removing the transferred cassette; and

transferring the removed transferred cassette to another position.

15. A method of treating a sample contained in a cassette using plural vacuum processing chambers according to claim 14, wherein the plural vacuum processing chambers comprise an etching chamber, a post-processing chamber, and a film-forming chamber.

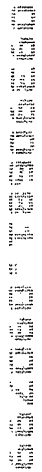
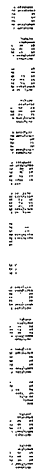
16. A method of treating a sample contained in a cassette using plural vacuum processing chambers according to claim 14, wherein after vacuum treating the respective carried-in sample using said respective vacuum processing chamber, the treated sample is then vacuum treated in another one of the plural vacuum processing chambers.

17. A method of treating a sample contained in a cassette using plural vacuum processing chambers according to claim 16, wherein the sample is vacuum treated in at least two of the plural vacuum processing chambers in sequence.

18. A method of treating a sample contained in a cassette using plural vacuum processing chambers according to claim 14, wherein the plural vacuum processing chambers include at least one of an etching chamber, a post-processing chamber and a film-forming chamber.

ABSTRACT OF THE INVENTION

This invention relates to a vacuum processing apparatus having vacuum processing chambers the insides of which must be dry cleaned, and to a method of operating such an apparatus. When the vacuum processing chambers are dry-cleaned, dummy substrates are transferred into the vacuum processing chamber by substrates conveyor means from dummy substrate storage means which is disposed in the air atmosphere together with storage means for storing substrates to be processed, and the inside of the vacuum processing chamber is dry-cleaned by generating a plasma. The dummy substrate is returned to the dummy substrate storage means after dry cleaning is completed. Accordingly, any specific mechanism for only the cleaning purpose is not necessary and the construction of the apparatus can be made simple. Furthermore, the dummy substrates used for dry cleaning and the substrates to be processed do not coexist, contamination of the substrates to be processed due to dust and remaining gas can be prevented and the production yield can be high.

[illegible][illegible]

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

VACUUM PROCESSING APPARATUS AND OPERATING METHOD THEREFOR

the specification of which (check one) ☒ is attached hereto.

☐ was filed on _____
as Application Serial No. _____
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

| | | | | |
|------------------------------|---------------------------|---|--|--------------------------------|
| <u>02-225321</u> (Number) | <u>Japan</u> (Country) | <u>29, August, 1990</u> (Day/Month/Year Filed) | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| _____ (Number) | _____ (Country) | _____ (Day/Month/Year Filed) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| _____ (Number) | _____ (Country) | _____ (Day/Month/Year Filed) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| _____ (Number) | _____ (Country) | _____ (Day/Month/Year Filed) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| _____ (Number) | _____ (Country) | _____ (Day/Month/Year Filed) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| _____ (Number) | _____ (Country) | _____ (Day/Month/Year Filed) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| | | |
|-----------------------------------|------------------------|---|
| _____ (Application Serial No.) | _____ (Filing Date) | _____ (Status: patented, pending, abandoned) |
| _____ (Application Serial No.) | _____ (Filing Date) | _____ (Status: patented, pending, abandoned) |
| _____ (Application Serial No.) | _____ (Filing Date) | _____ (Status: patented, pending, abandoned) |
| _____ (Application Serial No.) | _____ (Filing Date) | _____ (Status: patented, pending, abandoned) |

Reg. No. 32,087 and James Dresser, Reg. No. 22,973 to prosecute and transact all business connected with this application and any related United States application and international applications. Please direct all communications to the following address:

Antonelli, Terry, Stout & Kraus
Suite 600
1919 Pennsylvania Avenue, N.W.
Washington, D.C. 20006
Telephone: (202) 828-0300

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

| | (Full Name) | (Signature) |
|--|-----------------------------------|--------------------------|
| Date <u>Aug. 1, 1991</u> | Inventor <u>Shigekazu KATO</u> | <u>SHIGEKAZU KATO</u> |
| Residence <u>Same as Post Office Address</u> | | Citizenship <u>Japan</u> |
| Post Office Address <u>12-4, 3-chome, Toyo, Kudamatsu-Shi, Yamaguchi-Ken, Japan</u> | | |
| Date <u>Aug. 1, 1991</u> | Inventor <u>Kouji NISHIHATA</u> | <u>Kouji Nishihata</u> |
| Residence <u>Same as Post Office Address</u> | | Citizenship <u>Japan</u> |
| Post Office Address <u>6-37, 3-chome, Toishi, Tokuyama-Shi, Yamaguchi-Ken, Japan</u> | | |
| Date <u>Aug. 1, 1991</u> | Inventor <u>Isunehiko TSUBONE</u> | <u>Isunehiko Tsubone</u> |
| Residence <u>Same as Post Office Address</u> | | Citizenship <u>Japan</u> |
| Post Office Address <u>1-47, Iwagari-Cho, Hikari-Shi, Yamaguchi-Ken, Japan</u> | | |
| Date <u>Aug. 1, 1991</u> | Inventor <u>Itsushi ITOU</u> | <u>Itsushi Ito</u> |
| Residence <u>Same as Post Office Address</u> | | Citizenship <u>Japan</u> |
| Post Office Address <u>499-3, Ikunoya, Kudamatsu-Shi, Yamaguchi-Ken, Japan</u> | | |
| Date _____ | Inventor _____ | |
| Residence _____ | | Citizenship _____ |
| Post Office Address _____ | | |
| Date _____ | Inventor _____ | |
| Residence _____ | | Citizenship _____ |
| Post Office Address _____ | | |
| Date _____ | Inventor _____ | |
| Residence _____ | | Citizenship _____ |
| Post Office Address _____ | | |
| Date _____ | Inventor _____ | |
| Residence _____ | | Citizenship _____ |
| Post Office Address _____ | | |
| Date _____ | Inventor _____ | |
| Residence _____ | | Citizenship _____ |
| Post Office Address _____ | | |